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On the Electron Gas Heat Capacity in Undergraduate Solid State JAVIER HASBUN, University of West Georgia — In undergraduate solid state physics the electronic energy, U_{el} , is calculated through the Fermi distribution function while the energy is weighted with the density of states. The electronic heat capacity is the derivative of the electronic energy with respect to temperature. Through this process, it is possible [1] to obtain a low temperature approximation for the heat capacity, C_{el} that's proportional to the temperature. It is of interest to do a numerical calculation of U_{el} from which the numerical C_{el} is extracted. However, the result obtained, while agreeing with the low temperature approximation, has a slope that's substantially different. The disagreement appears large as the temperature is increased from zero K. Here we show that the reason has to do with the constancy of the Fermi level. By including the self consistent behavior of the chemical potential, the deviation from zero Kelvin is much improved and the result seems to make better sense. The lesson learned is significant enough to be of great pedagogical importance as regards the heat capacity calculation and the behavior of the chemical potential with temperature.

[1] "Introduction to Solid State Physics," C. Kittel, 8th Ed. (John Wiley, NY 2005).

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